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ITS TECHNOLOGIES AND MATURE DRIVERS

The increasing number of older drivers in the United States is well documented. Drivers over age 65 accounted for 6.7 percent of all miles driven in 1990, and that proportion is expected to rise to 18.9 percent of all vehicle miles driven by 2030. Older residents, who have been driving since they were sixteen, continue to regard their drivers' licenses as symbols of their independence. In the Phoenix metropolitan area and other sprawling low-density urbanized areas, automobile travel seems essential.

Unfortunately, the per mile crash rates of drivers over age 65 are higher than those of any group except those under age 24, and they have the highest crash fatality rate. Unlike youthful drivers for whom speed and alcohol are primary causes of accidents, older drivers become involved in accidents because they find it difficult to note, interpret, and respond to visual cues. Merging and changing lanes is particularly challenging. As the number of older drivers increases, it is important to take advantage of opportunities to enhance driver safety through improved signage and technology.

A substantial proportion of current older drivers voluntarily limit their driving on fast-paced urban freeways, but others continue to drive on freeways regularly. For example, 52 percent of older drivers who responded to a 2002 survey in the Phoenix area reported that freeway driving was not at all difficult. These

confident drivers will soon be joined by urban and suburban baby boomers who grew up driving on urban freeway systems. Some analysts have argued that freeway driving is actually less challenging for older drivers than is driving on surface streets. Freeways offer fewer visual distractions and drivers can focus on managing their vehicles.

Challenges for Older Drivers

There are, however, some aspects of freeway driving that are stressful for mature drivers. The literature identifies several key elements: merging into traffic flow from on-ramps, reading and interpreting road signs, changing lanes, and responding quickly to road hazards. Physiological changes associated with the aging process contribute to that stress.

Researchers note a more rapid decline in visual acuity after about age 60. These changes are associated with sensitivity to glare, problems with peripheral vision, reduced ability to judge gaps in traffic flow, and limitations in distinguishing colors and contrast. Driving a vehicle requires an ability to respond to visual cues, multi-task, switch the focus of attention, and prioritize efficiently. Studies find that all those skills decline with age.

Intelligent Transportation Systems (ITS) technologies, intended primarily to increase the efficiency of traffic flow and reduce congestion

on highways, can also help address a number of challenges faced by older drivers. These technologies include:

- Fixed electronic variable message signs (VMS)
- Portable electronic VMS signs
- Ramp meters
- Advanced Traveler Information Systems (ATIS) for road condition reports

Project Focus and Approach

The objective of this study for the Arizona Department of Transportation (ADOT) was to assess the responsiveness of older drivers (over age 65) to these ITS technologies, and conversely, to identify ways to increase their effectiveness in responding to the needs of older drivers. The primary approach involved a series of focus-group sessions with older drivers who regularly drive on the Phoenix-area urban freeway system, and who are familiar with deployment of ITS technologies.

Between October 2003 and March 2004, 11 focus groups were held with drivers over age 65 in varied settings across the Phoenix metropolitan region. Both year-round residents and winter visitors were represented. An additional focus group with drivers aged 40-55 provided a control group. Focus-group discussions were augmented by short surveys and trip logs documenting the travel patterns of participants.

Participants also took a "Trails Test," a test for motor speed, visual acuity, and attention function that requires the participant to sequentially connect letters and/or numbers randomly scattered on a page. Performance on the Trails Test is age-sensitive.

A parallel study reviewed ADOT accident data associated with the Phoenix area freeway on-ramps for the period 2000-2003 when ramp meters were deployed with data for 1996-1999, when only a few ramp meters were in use. Data was retrieved for older drivers and for a control group of drivers aged 40-50.

Small groups of older drivers also participated in in-depth usability studies (heuristic studies) of two evolving Arizona ATIS systems: the 511 traveler information system, www.AZ511.com, the ADOT website. Both systems were reviewed in March and the updated website was reviewed again in July, 2004.

Findings and Recommendations

Participants in the focus groups were experienced older freeway drivers living in different parts of the Phoenix area. Seventy percent of them had also driven on freeways in other areas of the country in the last six months. Overall, they agreed that VMSs were helpful in alerting drivers to key information that they might otherwise have missed. They were enthusiastic about ramp meters that they felt gave them lead time to judge a gap in the flow of traffic on freeways. They were also enthusiastic about accessing current road condition reports before starting their trips.

Through discussions in the focus groups they proposed ways to make these technologies even more valuable. Their suggestions would help to compensate for challenges that are associated with the aging process —problems with visual acuity while in motion, contrast, brightness, peripheral vision and speed of response. The following summarize the group responses:

Fixed Variable Message Signs

The older drivers agreed that the large, centrally-placed fixed VMS with yellow letters on a black background were easier to read than the standard painted highway signs, yet reading any sign while driving at freeway speed is challenging. Focus-group participants urged using the signs only to convey critical directions to drivers about current road conditions. Older drivers cannot absorb lengthy messages quickly, and abbreviations can distract and confuse them. Given the challenge of reading signs while driving, focus-group participants opposed using VMSs to post ozone alerts, convey general information, or to warn motorists about

restrictions several days in the future. (They did, however, favor posting of “Amber Alerts,” emergency notifications regarding missing children.)

It is essential that electronic signs are as bright as possible and use high contrast to minimize the glare of bright sunlight. Some focus group participants had limited their night driving, but they regularly drove in late afternoon when glare was a major issue. They urged that text on elongated signs be limited to two lines. Where possible, key messages should be centered in the middle of the sign, so they can be read quickly. Putting the same message on more than one sign can reinforce the directive to the driver.

Portable Message Signs

Portable electronic signs succeed in capturing the attention of older drivers when they are within their line of vision. However, if these signs are to communicate, they must be read, and the driver must respond appropriately. High contrast and sharp resolution are essential to compensate for glare. The ideal placement is both the median and the right side, but that is not always possible. The message can be lost to someone driving in heavy traffic behind trucks or sport utility vehicles (SUVs). A partially read message can confuse the driver. Older drivers strongly opposed conveying messages in two or more sequential phases. They favored using signs on high trailers to convey short messages with only essential directions for the driver. Ideally signs should be placed both in the median and on the right side. Placing two electronic signs with the same message in advance of a construction zone would help—one sign would alert the driver and the second reinforce the message.

Ramp Meters

Ramp meters, intended primarily to assure freeway traffic flow, also have the additional benefit of giving drivers a bit more time to judge a gap in traffic and to merge onto freeways. On-ramps with two lanes are confusing and invite competition among drivers,

but the current practice of using separate sets of signal lights for each lane helps to address this problem. The double signals—angled to be seen by the front driver and those behind—are helpful in alerting waiting drivers. Mature drivers are slower to merge than are younger drivers, and they find it difficult to accelerate after stopping at the signal. Focus-group participants found acceleration lanes helpful in getting up to freeway speed and in permitting impatient drivers behind them to enter the flow more quickly.

Accident Assessment

Accident records indicated that there were far fewer crashes involving older drivers in the period 2000-2003 than in 1996-1999. Despite an overall 43 percent increase in the number of crashes in all areas of the Phoenix metropolitan area and a greatly expanded freeway system, the number of accidents involving older drivers at on-ramps declined from 194 to 115 in the second three-year period. About half of the accidents (59) in the recent period were in peak hours. The number of crashes at on-ramps involving drivers aged 40 to 50 similarly declined. It is not possible to attribute this decline of accidents directly to the installation of ramp meters. Still, the ramp meters in combination with new acceleration lanes seem to have had an impact. The overall reduction in accidents at on-ramps is impressive.

Traveler Information System: Dedicated 511 Telephone Number

Mature drivers were enthusiastic about information that would assist with trip planning and help them avoid problematic roadway conditions. Information presented from points of origin to points of destination would be most helpful. In assessing the emerging Arizona 511 telephone system, mature drivers both in focus groups and in heuristic evaluation sessions underscored the importance of brevity and simplicity in providing instructions for the dial-up system. They underscored the importance of an early announcement of a backup keypad system as an alternative to voice recognition. Much as busy commuters, the older drivers

wanted information quickly without putting forth much effort. They wanted a simple menu with clear, short instructions, and the ability to key ahead to get information linked to their specific trip.

Traveler Information System: AZ511.com Internet Site

In almost all focus groups a number of participants reported regularly using home computers to get trip directions; some had Global Positioning Systems (GPS) installed in their vehicles. Focus-group comments and the observations of participants in the two heuristic assessments of the emerging ADOT web site highlighted key factors that would enhance usability. In the earlier heuristic review the older driver panel wanted a clearer, simpler site. To minimize visual confusion, participants suggested using a simple high-contrast state highway map with icons replaced by geometric shapes in contrasting colors that would be easy to see and interpret. Road condition information should be grouped into a few major categories with definitions evident to all site users. The site should relate to travel agendas of individual users, and be organized to zoom in to specific to origins and destinations. They felt consistency in the classification scheme between the dial-up and Internet service was essential.

In the second heuristic study (discussed in Appendix G of the report) the reviewers saw a site with a simpler road conditions map, as well as opportunities to access blow-up maps of places of interest. They urged that the pattern of navigation through the site be clearer. They looked for a help button or a functioning scroll bar, and guidance about how to access available

blow-up maps. They felt that a link between the freeway speed map and the highway conditions map would provide explanations for slow traffic.

Conclusion

The mature drivers recommended simplicity of message, clarity in presentation, and sharpness of image related to all of the technologies explored in this study. Older drivers have increasing problems with visual acuity, and in processing and responding quickly and effectively to visual cues. Hence short messages focusing specifically on the action required of drivers can reduce confusion and increase the speed of response. Minimizing glare in bright sunlight is particularly challenging in Arizona.

VMSs, particularly the fixed signs, make an important contribution, but the goal must be sharpening the image, enhancing legibility, and increasing communication. With ATIS similar recommendations apply. Short simple instructions on the telephone, with a clear backup system to voice recognition, can minimize frustration and increase usefulness to older drivers, particularly those with declining hearing ability. A web site with enhanced usability is easy to negotiate and conveys information helpful for planning individual trips.

These guidelines respond specifically to needs of older drivers, but they can also benefit hurried commuters who want to grasp key information efficiently, and in time to take alternative action. ITS technologies can and do enhance communication with older drivers. As such, they can increase the safety of the highways for all drivers.

The full report: *ITS Technologies and Older Drivers*, by Dr. Mary Kihl with Sweta Bansal, Jennifer Brungart, Aaron Gannon, Thara Johnson, and Debarati Majumdar, Arizona State University (Arizona Department of Transportation, report number FHWA-AZ-04-562, published July 2004) is available on the Internet. Educational and governmental agencies may order print copies from the Arizona Transportation Research Center, 206 South 17th Avenue, MD 075R, Phoenix, AZ 85007; FAX 602-712-3400. Businesses may order copies through ADOT's Engineering Records Section.